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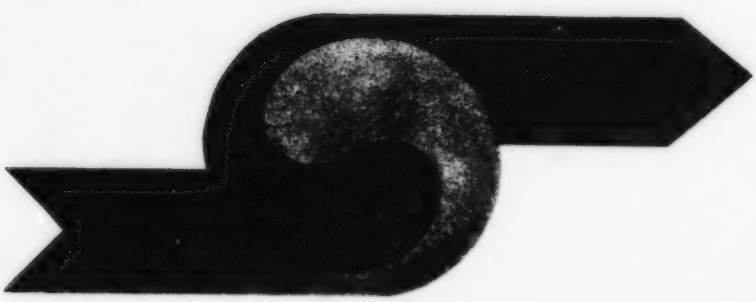
Heat Pump Program
Programme des pompes de chaleur

The Monitoring of a Templifier Heat Pump

F.J. Gazzola

February 1984



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THE MONITORING OF A TEMPLIFIER HEAT PUMP

- A STUDY -

FINAL REPORT

CONTRACT SERIAL NUMBER: 09SX.31155-0-2714

F. J. Gazzola
Energy Technologist

February 1984

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ABSTRACT

A waste heat recovery system which employs a Westinghouse Templifier Heat Pump has been in operation at Monarch Fine Foods since March of 1982. The data collected through continuous monitoring and recording instruments provided by Ontario Hydro serves as the basis for evaluating the performance of this Heat Pump over the course of a 12 month study period.

During the commissioning phase of this project, some significant operational difficulties were encountered with the heat pump, ancillary equipment or process equipment. In this final analysis 12 months have passed with only minor problems.

The heat recovery system has been successful in reducing energy costs by $92,360 throughout this study period; however, the net savings of $9,303.00 derived from the heat pump alone is somewhat disappointing.

RÉSUMÉ

Un système de récupération de chaleur monté autour d'une pompe à chaleur Westinghouse Templifier est en exploitation à la Monarch Fine Foods depuis mars 1982. Les données collectées à l'aide d'appareils de contrôle et d'enregistrement en continu fournis par l'Ontario Hydro servent de base à l'évaluation du rendement de cette pompe au cours de la période d'étude de 12 mois.

On a éprouvé d'importantes difficultés avec la pompe à chaleur, le matériel auxiliaire et le matériel de fabrication pendant la phase de mise en service. Mais au cours de l'analyse finale, il ne s'est posé que de petits problèmes en 12 mois.

Le système de récupération de chaleur a permis de réduire de 92 360 $ les coûts d'énergie au cours de la période d'étude. L'économie nette de 9 303 $ réalisée à l'aide de la pompe uniquement déçoit un peu.

INTRODUCTION

Monarch Fine Foods Company Limited of Rexdale, Ontario have been operating a waste heat recovery system, illustrated in Figure 1, in which feedwater to the boilers is pre-heated using cooling water discharged from two deodorizing vessels since March of 1982. The principle components of the recovery system are a plate type heat exchanger and a centrifugal heat pump.

At the onset of this project, sophisticated electronic monitoring equipment provided by Ontario Hydro and Monarch Fine Foods was incorporated into the system to record operating characteristics of the heat pump and provide a means to evaluate energy savings.

This report presents the findings of a 12 month study period based on data collected during this time span and also comments on experiences encountered with its operation.

PLANT DESCRIPTION

Monarch Fine Foods Company Limited is a wholly owned subsidiary of Lever Brothers Limited (Canada), with other subsidiaries being, Lever Detergents Ltd., Maple Leaf Monarch Ltd., Myriad Detergents Inc., Newfoundland Margarine Ltd., Hygrade Foods Inc., Shopsy's Foods Ltd., A&W Food Services of Canada Ltd., Hart Chemical Ltd., and Woodbridge Moulded Products Ltd.

The manufacturing facility of Monarch Fine Foods, located in Rexdale, Ontario, stands on a 9.5 acre site and consists of a Fractionation Plant, Edible Oil Refinery and a Packaging Plant which also houses the power plant.

The prinicpal processes in the Edible Oil refinery are:

Alkali Refining	Bleaching
Hydrogenation	Interestification
Solvent Fractionation	Deodorization

The Packaging Plant utilizes edible deodorized oils to make a variety of packaged margarines, oil and shortening products.

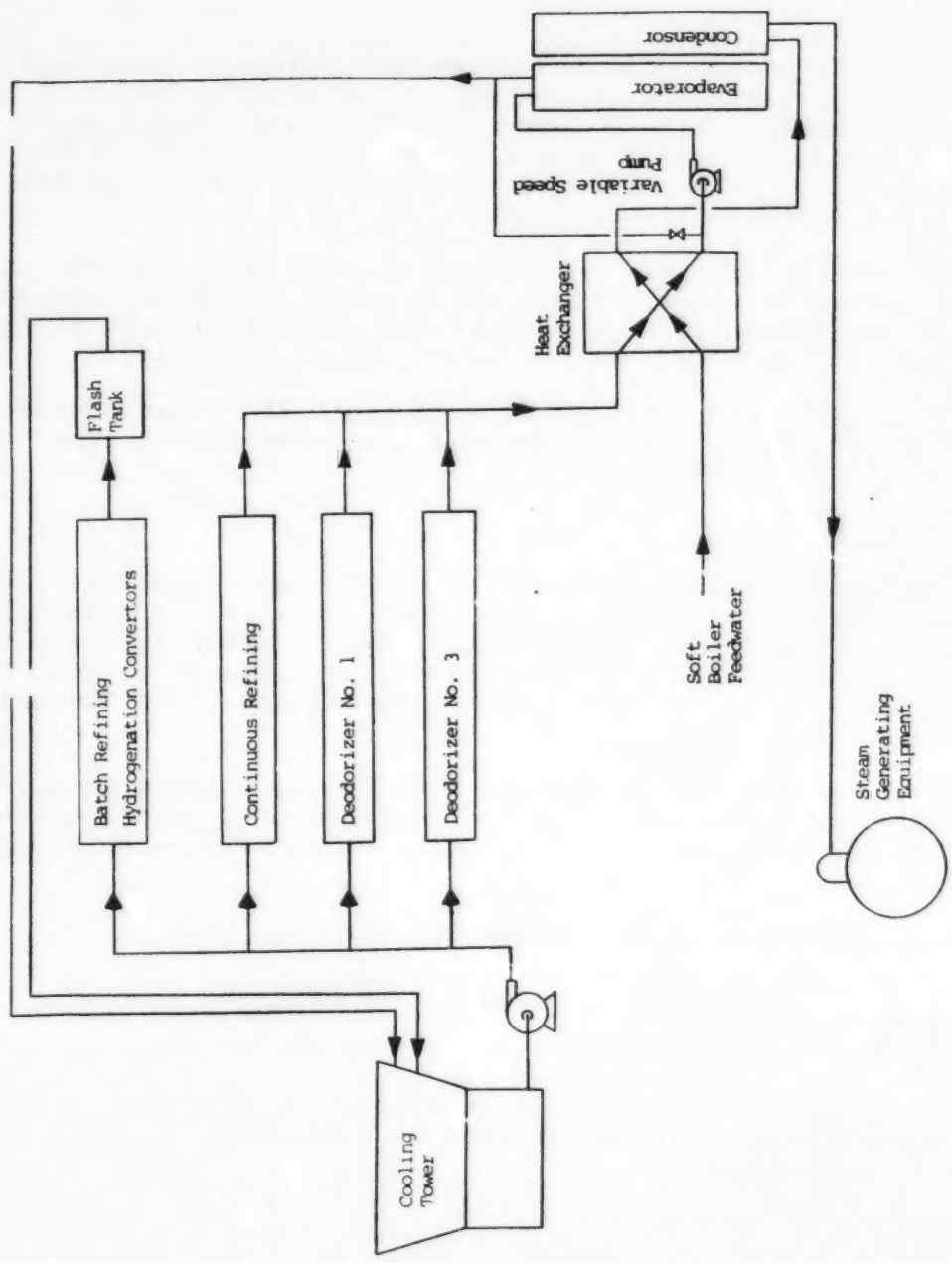


Figure 1: Heat Recovery Circuit

SOURCES OF WASTE HEAT

In August of 1982, several major changes were made to process equipment that altered the characteristics of the source water flow and temperature profiles from the original concepts adopted for development of the Heat Pump project. Specifically, two of the original four deodorizers were removed from continuous service and the remaining two were modified to increase their capacity. The sources of waste heat now contributing to the heat pump recovery system are detailed in the following process descriptions.

DEODORIZER NO. 1 - CONTINUOUS

This unit was modified to increase its operating capacity by roughly 12.0%. Cooling is accomplished in two stages. Initial cooling takes place within the deodorizer vessel itself where oil temperatures are reduced from 500°F to 250°F. Further cooling to 130°F takes place in a finned tube heat exchanger. In both cases, cooling tower water is used and the heat transferred to the system is 2.1×10^6 BTU/hr.

DEODORIZERS NO. 2 AND NO. 3

Deodorizer No. 2 is no longer operated on a regular basis however, it is a backup unit should No. 1 fail.

Deodorizer No. 3 has been removed from service, forfeiting 1.5×10^6 BTU/hr.

DEODORIZER NO. 4 SEMI-CONTINUOUS

This unit was also modified to increase its capacity by 50%, thus allowing for the removal of unit No. 3. Oil is cooled from 500°F to 130°F within a 15 minute cycle. The heat transferred to the source is 3.2×10^6 BTU/hr.

CONTINUOUS REFINERY

Bleached oil is cooled on a continuous basis from 240°F to 160°F before pumping to storage. Cooling is accomplished in a plate heat exchanger and the heat transferred to the cooling water is 0.60×10^6 BTU/hr.

HYDROGENATION CONVERTORS

This process is carried out in a batch vessel and requires cooling at the end of the cycle. Cooling is accomplished in approximately 1 hour, bringing the charge in the vessel from 400-450°F to about 225°F. The operation is performed a number of times in a 24 hour period with some overlap in the cycle times possible. Cooling water leaving the coils runs into a flash tank and then returns to the cooling tower reservoir. Each batch transfers $3.0\text{-}4.0 \times 10^6$ BTU to the cooling water. Some heat is lost in the return but with the tower fan turned off, considerable heat is added to the system. The net effect is to raise the temperature of the source water to the heat recovery system by about 15-20°F.

BATCH REFINERY

This process gives up about 2.0×10^6 BTU/batch. Cooling is accomplished in about 1/2 hour and takes place several times a day. This process also runs to a flash tank and then returns to the tower reservoir.

WASTE HEAT SOURCES Table I

Equipment	Heat Available (BTU/Hr.)
Deodorizer No. 1	2.1×10^6
No. 2	N/A
No. 3	No longer in service (was 1.5×10^6)
No. 4	3.2×10^6
Continuous Refinery	0.6×10^6
4 - Hydrogenation Convertors	1.5×10^6
4 - Batch Refinery Vessels	0.3×10^6
Total	7.7×10^6

THE HEAT RECOVERY SYSTEM

The heat recovery system consists of a plate heat exchanger and heat pump, depicted in Figures 2 and 3, arranged in a series circuit.

Heated source water leaves the plant processes and is piped to the inlet of the heat exchanger. At this point boiler feedwater enters the recovery system and heat from the source water is transferred to the boiler feedwater. As the source water exits the heat exchanger, a variable speed pump delivers a portion or all of this stream to the heat pump evaporator. On the condenser side of the heat pump the full flow of boiler feedwater is allowed to pass.

The source water now returns to the cooling tower reservoir for reuse and the heated boiler feedwater is brought to the boilers for conversion to steam.

As part of the ancillary equipment required for the system, an ultra-violet oil-in-water analyzer is used to detect oil in the boiler feedwater. If oil is detected in the feedwater, the heat recovery system is bypassed until the situation is corrected. Also, an in-line flow divertor is used as part of the foulguard cleaning system for the evaporator tubes.

MAJOR EQUIPMENT LIST — Table II

Heat Exchanger	-	Alpha-Laval Plate Heat Exchanger AM-10-HBM Surface Area 222.2 ft.^{2} Stainless Steel Plate Source Water - Triple pass Feedwater - Single pass
Heat Pump	-	Westinghouse (McQuay) Templifier TPE-C063 Refrigerant - R-114 (dichlorotetra fluoraethane) equipped with foulguard evaporator cleaning
Variable Speed Pump	-	Atlas Centrifugal Pump 4070-9 coupled to a Parametrics AC frequency controller PN 68001
Oil in Water	-	Teledyne 660

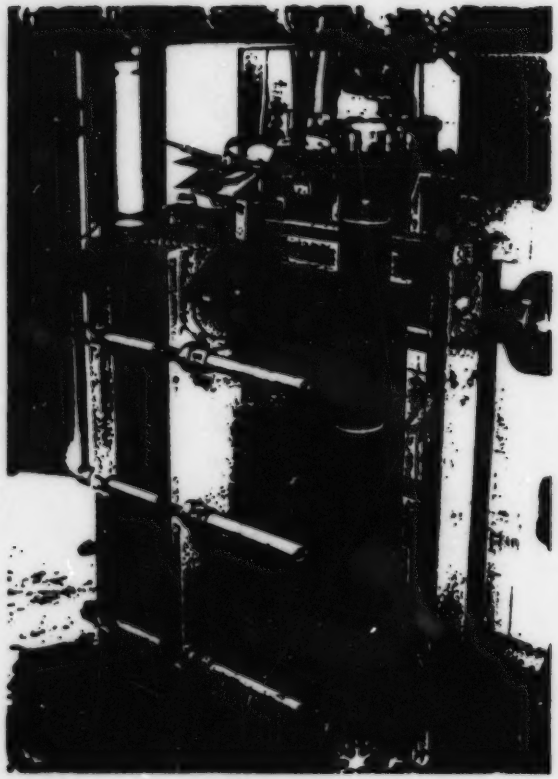
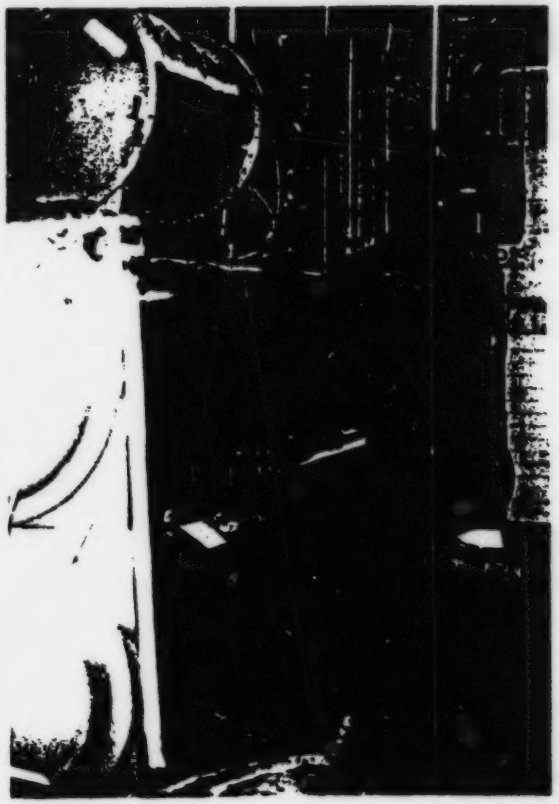


Plate Heat Exchanger



Templifier Heat Pump

Figure 2: Heat Recovery System

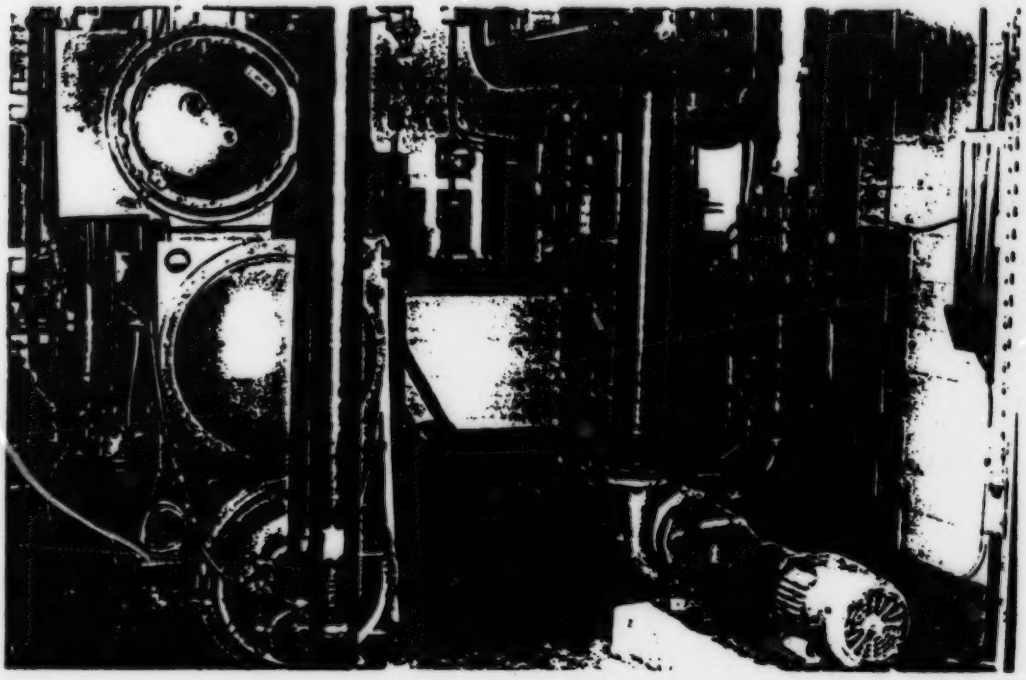


Figure 3: Heat Recovery System

Capital Investment

The capital investment required for the complete installation of the heat exchanger and heat pump totalled $224,096.

The major cost item was the heat pump at a cost of $81,090. The other major cost item was the piping of the source and feedwater lines from the plant to the installation site as both distances were significant. The heat exchanger cost was $8,200 and represents only a small portion of the total cost. Other items of significance are the building itself at $18,700, the oil in water analyzer at $13,800 and the vaiable speed pump at $12,664.

Table 3 is a detailed breakdown of the costs incurred for this project.

CAPITAL COSTS FOR HEAT RECOVERY SYSTEM — TABLE 3

Equipment		
Heat Exchanger	$ 8,200	
Heat Pump with Foulguard cleaning	81,090	
Variable Speed Pump	12,664	
Oil in Water Analyzer	13,800	
Miscellaneous	3,894	
	$119,648	$119,648
Mechanical		
Piping	$ 41,200	
Valves and Fittings	6,000	
Pumps	2,000	
Installation	8,800	
	$ 58,000	$ 58,000
Electrical		
Materials and Installation	$ 14,317	$ 14,317
Building	$ 18,700	$ 18,700
Instrumentation		
Thermocouples, Pressure Transducers, Recorders Calibration of Equipment	$ 9,327	$ 9,327
Miscellaneous		
Engineering	$ 2,604	
Drafting	1,500	
	$ 4,104	$ 4,104
Total Capital Expenditure		$224,096

Total Heat Pump	$ 140,914
Total Heat Exchanger	83,182
	$ 224,096

HEAT PUMP MONITORING EQUIPMENT

The equipment used to monitor the heat recovery system was installed through a joint effort on behalf of Monarch Fine foods and Ontario Hydro.

For specific data on energy recovery and energy balances, Ontario Hydro supplied magnetic tape logging devices which utilize RTD probes and pulse generators. This information is continuously monitored and the information is recorded at 15 minute intervals. The pulse or digital information is processed into engineering units by Ontario Hydro's computor. The 12 points monitored by this equipment are listed below:

Source Water	flow rate to heat exchanger inlet temperature outlet temperature flow rate to heat pump evaporator inlet temperature to heat pump evaporator
Boiler Feedwater Makeup	flow rate to heat exchanger inlet temperature to heat exchanger outlet temperature from heat exchanger inlet temperature to heat pump condensor outlet temperature from heat pump condensor
Electrical	heat pump kilowatt-hour consumption variable speed pump kilowatt-hour consumption

Heat Pump Monitoring Equipment as supplied by Monarch Fine Foods includes the following:

Temperature

Three type "J" general purpose thermocouples are surface mounted, with a range of 0-300°F. The following temperatures are recorded on a multipoint, 0-100%, strip chart recorder:

1) Suction to compressor,
2) Discharge from compressor,
3) Liquid discharge from condensor.

Pressure

Four pressure points on the refrigerant are recorded on a 0-100% multipoint strip chart recorder, with a range of 0-250 psig. The pressure sensors utilize silicon semi-conduction strain gauges and are piped directly to the refrigeration system. The following points are monitored:

1) Suction to compressor,
2) Discharge from compressor,
3) Liquid discharge from condensor,
4) Feed to evaporator.

Recording

Temperatures and pressures are recorded on separate GANZ Recorders. Each chart is manually aligned and sychronized to operate at 20 mm/hr. and on Standard Time (to operate in phase with Hydro recorders). Numbers down the chart indicate hours on a 24 hour clock. The scale across the chart is a percent scale. These charts are changed monthly.

Source Water

Two Liquid filled capillary sensors with a 0-240°F range are recorded on a 24 hour 10" diameter chart. Points measured are:

1) Source water to Heat Exchanger,
2) Source water to Heat Pump (same as Heat Exchanger outlet)

Source Water Flow Rates and Temperatures

Two 500 USGPM centrifugal pumps provide cooling water to all of the users and have adequate head to return the water to the cooling tower. The reservoir and associated piping have an approximate capacity of 75,000 pounds of water. Flow rates through each process are dependent on the number of operations requiring cooling water simultaneously. One meter is used to measure this combined flow.

Typically, the observed flow changes in a step-wise fashion due to the cyclical operation of the semi-continuous deodorizer (see Fig. 4 for a graphical representation of flow rate fluctuations).

Higher than required flow rates are observed when the number of users drops off. For example, flows through the continuous operations run at 300 USGPM when the semi-continuous deodorizer is not cooling. This results in a temperature rise from the reservoir of about 10-15°F resulting in reduced recovery. Typical temperature rises are about 30°F.

Recovery of heat is also adversely affected by the flow of cooling water through processes that are not contributing heat. This condition occurs during feed stock changes and is observed by a drop in source water temperature. Flow is also maintained through processes that are shutdown, for freeze protection.

Fluctuations in source water temperature are dependent on many factors. Cooling water temperatures from the tower are influenced by the batches that return hot water directly to the cooling tower. These sources cause the mean temperatures to drift upwards. Increased recovery rates gradually drop this mean temperature, until further heat is again added. Amplitudes of about 20F° are observed due to this phenomenon. More rapid fluctuations in temperature are due to the cyclical batch cooling of the semi-continuous deodorizer.

The temperature rise in cooling water is a function of water flow rate, but observed temperature rises may begin at 40F° and drop to 10F° by the end of the cycle. Variations in flow rate, previously mentioned, will alter these conditions. Figure 5 is a sample chart of the temperature fluctuations discussed above.

This description should serve as a basis for qualitatively understanding changes in the source water stream.

Boiler Feed Make-up Water

The boilers operate with 97% city water make-up. This stream serves as the heat sink for all the waste heat transfered. Process demands dictates the through-put, and flow rates are generally between 50,000 pph and 100,000 pph. High demand does not necessarily mean high source loading since the boilers supply two independent plants, with recovery from one only. Temperatures vary seasonally for the city water and range from a low of 34°F to a high of 60°F. Figure 6 is a chart of steam boiler operation which gives some indication as to how flowrates for feedwater also fluctuate.

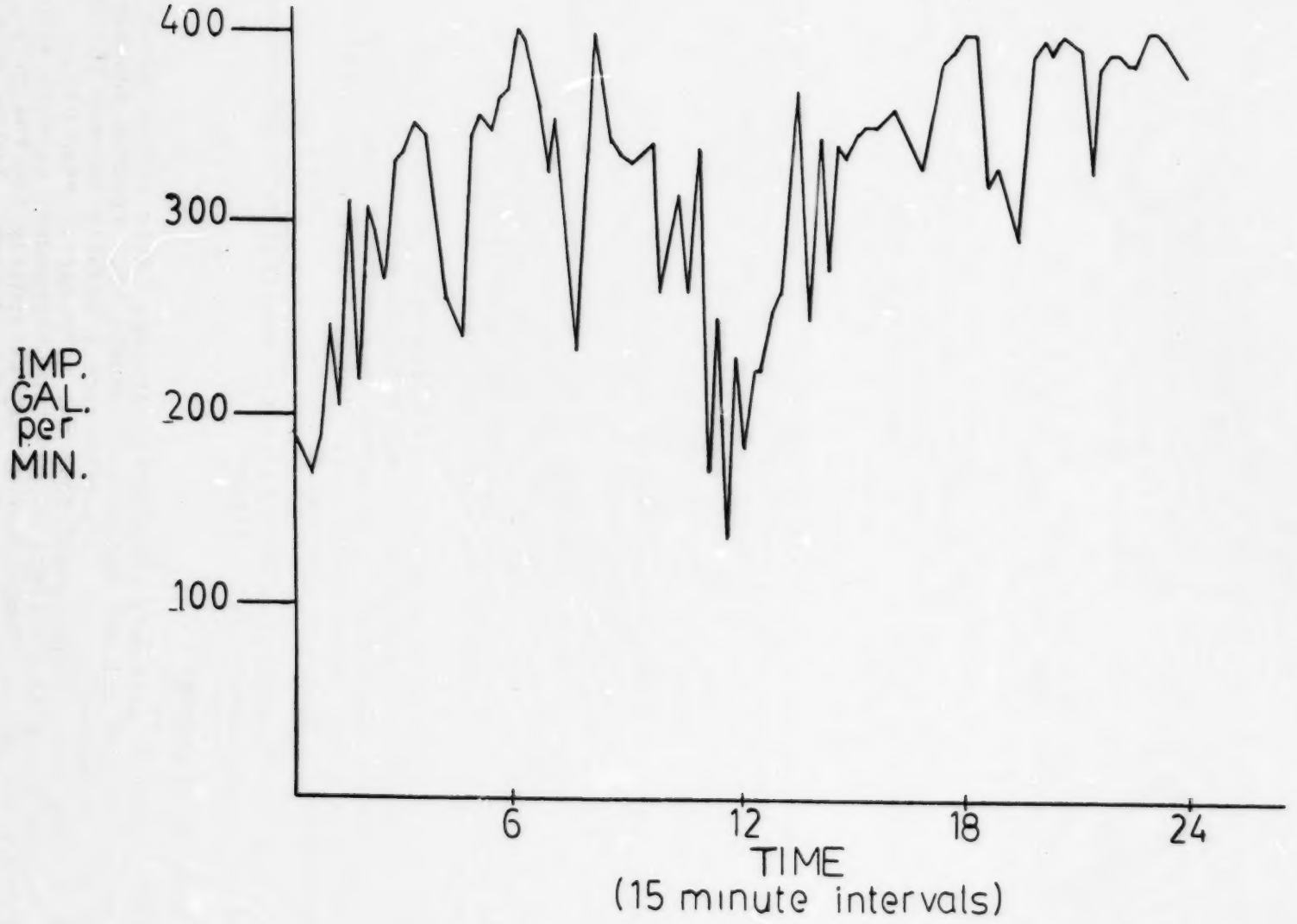
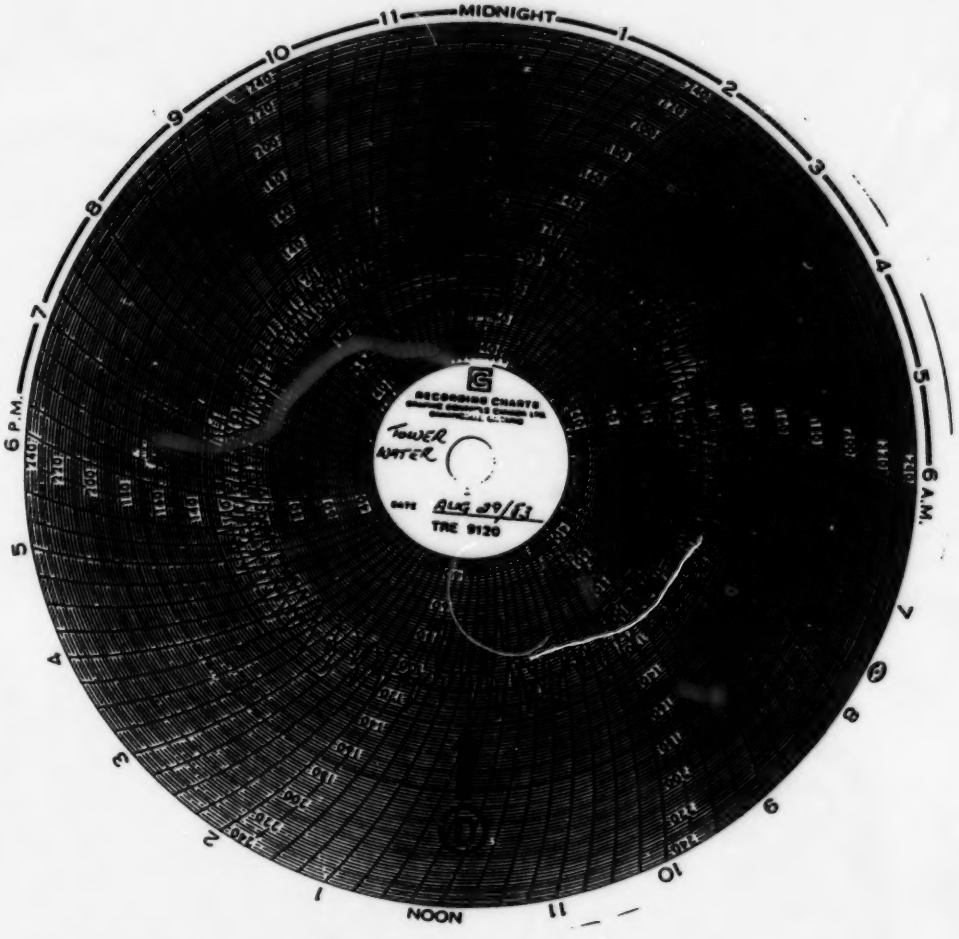
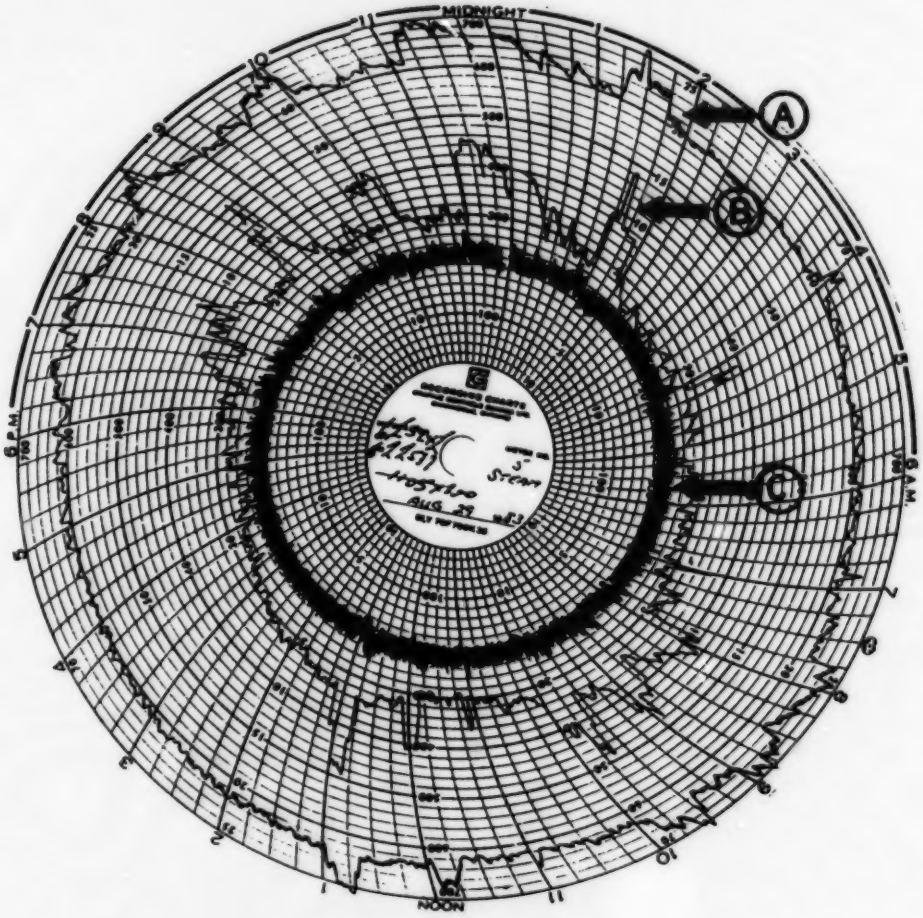


Figure 4: Source Water Flows (Sample for Aug. 29/82)



A Heat Exchanger Inlet Temp.
B Heat Exchanger Outlet Temp.
C Sample of temps with semi continuous deodorizer not cooling.
D Sample of temps during Feedstock Changes.

Figure 5: Source Water Temps. (Sample for Aug. 29/82)



A Flue gas temperature °F.

B Steam Output - PPh.

C Drum water level - inches.

Figure 6: Steam Generation (Sample for Aug. 29/83)

CONCLUSIONS

Table 4 summarizes the data contained in Apendix I, collected on the operation of the heat pump for a 12 month period. From this data we can see that the heat recovery system has proved worthy of the capital invested for the total project, however examination of the components on an individual basis reveals some interesting conclusions.

1) The total energy added to the boiler feedwater stream amounts to 17.9×10^9 BTU. This energy at a value of $5.50 per million BTU's is a savings of $98,653.

2) The energy recovered from the operation of the heat pump alone, for this study period was only 2.8×10^9 BTU's or 15.8% of the total savings.

3) Associated with the operation of the heat pump is an operating cost of $6,293, i.e. 580×10^6 BTU's for the compressor motor and 70.6×10^6 BTU's for the variable speed pump.

4) The net savings derived from the operation of the heat pump is therefore $9,303.

5) The average rate of recovery was 1.1×10^6 BTU's/hr and the average operating C.O.P. was 4.85.

6) The run time of the heat pump was 2,536 hrs. out of a possible 8,098.5 hrs. included in the study period. This equates to a "load factor" of 31.3% however, if the time for non-productive periods i.e. weekends and scheduled plant shutdowns is ignored, the load factor improves to 48.3%.

At the onset of this project, preliminary calculations assessed a recovery rate of 2×10^6 BTU/hr. and an operating C.O.P. of 5.2. In actual use the average rate of recovery has been only 1.1×10^6 BTU/hr. and the average C.O.P. was only 4.85. Thus for every unit of energy output 0.21 units of energy in was required.

The simple payback for this project, based on energy savings as mentioned above is 2.40 years however, on an individual basis, the return on the heat pump is realized in 15.1 years and the heat exchanger is realized in 1.1 years.

HEAT PUMP OPERATION SUMMARY

Table III

Total BTU Across Heat Pump on Feedwater	Total BTU Across Heat Pump on Source Water	Total BTU Across Heat Exchanger on Feed Water	Total BTU Across Heat Exchanger on Source Water	Energy Used To Drive Variable Speed Pump	Energy Used To Drive Heat Pump	Total Hours in Study Period	Total Hours Heat Pump In Operation
2,835,698,941	1,725,511,067	15,101,286,630	13,280,145,180	70,600,082	580,488,382	8,098.5	2,536

Savings: * 1 Value of Energy saved at

Heat Exchanger	$ 83,057
Heat Pump	15,596
Total	$ 98,653

* 2 Operating Costs for

Heat Pump	$ 5,611
V.S. Pump	682
Total	$ 6,293

Net Recovery Savings = $98,428 - $5,263 = $93,165

*1 Based on an Energy value of $5.50/1 x 10^6 BTU

*2 Based on an Energy value of $0.033/KwHr.

Load Factor: Full Year $\frac{2,536 \text{ hr}}{8,098 \text{ hr}} \times 100 = 31.3\%$

Ignoring scheduled interruptions $\frac{2,536 \text{ hr.}}{(8,098-2,850)\text{hr.}} \times 100 = 48.3\%$

Technical Discussion

During the commissioning phase of the heat pump project, some significant problems were encountered with the unit itself or its ancillary equipment.

Initial "tuning" of the unit proved to be difficult as fluctuations in both the heat source and heat sink flows were too severe. An attempt was made to smooth out these changes by limiting the source water flow to a constant rate. Although this proved to be beneficial to the heat pump, it did adversly affect process temperatures and was thus abandoned. Under the conditions in the plant at that time, the heat pump was set up to function, however the rate of heat recovery was below that expected.

In the first four months of operation it ran trouble free until the oil in water analyzer failed. This instrument required a lengthy time to obtain parts and since then replacement parts are now kept on hand. Once the unit was repaired, a second problem was discovered. During the delay, refrigerent has migrated into the lubricating oil thus creating difficulties in maintaining oil pressures. To correct this, the system was recharged with fesh oil then restarted and ran well until our plant shutdown in mid-July of 1982.

After this scheduled plant shutdown of three weeks, the heat pump was restarted, however the oil in water analyzer would trip the system bypass. An inspection of the analyzer found an accumulation of iron deposits which upon further examination was traced back to the condensor piping, shell heads and tube sheets. The piping was replaced with copper piping and the condenser heads and tubesheets were brushed clean and then coated with an epoxy cement to prevent further corrosion. During these repairs, an inspection of the evaporator tubes which are equipped with a "Foulguard" cleaning system were found to be satisfactory and did not require any further attention.

Upon restarting, the heat pump performed well until September of 1982 when for some, as yet unexplained reason, the compressor motor failed. The motor was replaced under the manufactuer's warranty and operations resumed. After this extended shutdown period, refrigerent was once again found in the lubricating oil and a fresh recharge was necessary in order to restart the heat pump. To prevent a re-occurrence of this problem, a separate electrical feed and thermostat for the oil heater was installed thereby preventing oil and refrigerent from mixing when the heat pump was turned off for prolonged periods.

In December of 1982 mechanical problems with the cooling towers created a situation where the temperatures of the source water were too low for the heat pump to operate. This delay lasted a full month and until repairs were made the heat pump was inoperative.

Once restarted, the unit ran well until late February 1983 when a thermister in the heat pump's "Surgeguard" control system failed. During the repairs, a test of the electrical system discovered an error in the setting of the over-load relays. It was then decided to suspend operations until the proper relays were installed.

With the proper relays installed in early April 1983, the heat pump ran for a two week period until the anti-cycle timer relay failed. The operation of the heat pump was suspended until the relay was replaced and an attempt to improve the operation of the heat pump was made. Action taken to improve the unit's operation included adjustment of the Low Source Water temperature cut out from 90°F to 85°F, also the flow of source water to the evaporator was maximized by closing the bypass around the variable speed pump, forcing the full flow of source water to pass through the evaporator. This resulted in longer run times of the heat pump and consequently improved heat recovery.

In total, the cost for maintenance and services for repairs to the heat pump listed above amount to $3,915.

To help improve the loading of the heat pump, we examined the possibility of installing a surge tank to act as a buffer in the source water stream. This would cause a smoothing out of the high temperature peaks and also would help to maintain flow rates at a relatively constant level. The capital required to do so was estimated to be $45,000 for an improvement of perhaps only 12.0% and was therefore considered not economically viable.

In addition, we also investigated the feasibility of improving heat recovery through the use of a second heat exchanger which would have totally nullified the need for a heat pump. At this time, a second heat exchanger would not prove to be economically viable as the law of diminishing returns is enforced, i.e. to extract more heat from the source water through a second heat exchanger would require a significant surface area thus the capital costs for such a heat exchanger would be quite high and the returns proportionately lower. Preliminary cost estimates determined that a capital investment of some $15,000 was required to achieve a further savings of only $5,000.

APPENDIX I

HEAT PUMP

PERFORMANCE DATA

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	12	5	0	15
:	TO	1983	12	15	10	15
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 186191010·00 *
(WHICH IS EQIVALENT TO 1209032·53 BTUS/HR-AVG· *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 70388076·00 *
(WHICH IS EQIVALENT TO 457065·43 BTUS/HR-AVG· *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 589344984·00
(WHICH IS EQIVALENT TO 2355024·91 BTUS/HR - AVG·)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 465042540·00
(WHICH IS EQIVALENT TO 1858311·84 BTUS/HR - AVG·)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 2335231·34 BTUS
(WHICH IS THE SAME AS 684·42 KW·H)
(WHICH WOULD BE EQUIVALENT TO 2·73 KW·H AVG· MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 36081820·00 BTUS *
(WHICH IS THE SAME AS 10574·98 KW·H)
(WHICH WOULD BE EQUIVALENT TO 42·26 KW·H AVG· MAINTAINED PER HOUR)

THE C·O·P· OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 5·16

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 26·729%

THE RATIO OF THE HEAT PUMP C·O·P· CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 74·8767 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 154·00 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 880·68
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 362·55
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 85·80
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	11	21	0	15
	: TO	1983	12	4	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 230188778·00 *
(WHICH IS EQIVALENT TO 1177436·20 BTUS/HR-AVG· *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 156719250·00 *
(WHICH IS EQIVALENT TO 801632·99 BTUS/HR-AVG· *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 694139216·00
(WHICH IS EQIVALENT TO 2065890·52 BTUS/HR - AVG·)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 573129992·00
(WHICH IS EQIVALENT TO 1705744·02 BTUS/HR - AVG·)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 3053589·44 BTUS
(WHICH IS THE SAME AS 894·96 KW·H)
(WHICH WOULD BE EQUIVALENT TO 2·66 KW·H AVG· MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 45310136·50 BTUS *
(WHICH IS THE SAME AS 13279·64 KW·H)
(WHICH WOULD BE EQUIVALENT TO 39·52 KW·H AVG· MAINTAINED PER HOUR)

THE C·O·P· OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 5·08

THE RATIO OFHX (2FW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 21·114%

THE RATIO OF THE HEAT PUMP C·O·P· CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 13·9383 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 195·50 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 1088·79
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 456·42
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 84·74
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	11	15	10	45
:	TO	1983	11	20	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 69593012·00 *
(WHICH IS EQIVALENT TO 1166493·92 BTUS/HR-AVG· *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 46815973·00 *
(WHICH IS EQIVALENT TO 783530·92 BTUS/HR-AVG· *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 236598120·00
(WHICH IS EQIVALENT TO 1772270·55 BTUS/HR - AVG·)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 204904344·00
(WHICH IS EQIVALENT TO 1534864·00 BTUS/HR - AVG·)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 1130256·73 BTUS
(WHICH IS THE SAME AS 331·26 KW·H)
(WHICH WOULD BE EQUIVALENT TO 2·48 KW·H AVG· MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 13922580·87 BTUS *
(WHICH IS THE SAME AS 4080·48 KW·H)
(WHICH WOULD BE EQUIVALENT TO 30·57 KW·H AVG· MAINTAINED PER HOUR)

THE C·O·P· OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 5·01

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 15·468%

THE RATIO OF THE HEAT PUMP C·O·P· CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 14·7509 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 59·75 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 329·67
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 142·06
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 85·27
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	11	7	0	15
:	TO	1983	11	15	10	15
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 125605251·00 *
(WHICH IS EQIVALENT TO 1131578·83 BTUS/HR-AVG· *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 77655973·00 *
(WHICH IS EQIVALENT TO 699603·36 BTUS/HR-AVG· *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 439970703·00
(WHICH IS EQIVALENT TO 2175380·50 BTUS/HR - AVG·)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 404546052·00
(WHICH IS EQIVALENT TO 2000227·69 BTUS/HR - AVG·)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 1644919·81 BTUS
(WHICH IS THE SAME AS 482·10 KW·H)
(WHICH WOULD BE EQUIVALENT TO 2·38 KW·H AVG· MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 25685767·25 BTUS *
(WHICH IS THE SAME AS 7528·07 KW·H)
(WHICH WOULD BE EQUIVALENT TO 37·22 KW·H AVG· MAINTAINED PER HOUR)

THE C·O·P· OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4·89

THE RATIO OF(X (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 8·757%

THE RATIO OF THE HEAT PUMP C·O·P· CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 21·5436 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 111·00 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 594·11
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 257·93
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 85·27
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	10	24	0	15
:	TO	1983	11	6	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 192691830.00 *
(WHICH IS EQIVALENT TO 1057293.98 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 113662635.00 *
(WHICH IS EQIVALENT TO 623663.29 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 694447832.00
(WHICH IS EQIVALENT TO 2066309.02 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 639776776.00
(WHICH IS EQIVALENT TO 1904097.55 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 2448350.31 BTUS
(WHICH IS THE SAME AS 717.72 KW.H)
(WHICH WOULD BE EQUIVALENT TO 2.14 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 41023741.50 BTUS *
(WHICH IS THE SAME AS 12023.37 KW.H)
(WHICH WOULD BE EQUIVALENT TO 35.78 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4.70

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 8.545%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 24.5694 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 182.25 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 911.43
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 410.26
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 82.63
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	10	14	9	15
	: TO	1983	10	23	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 135025336.00 *
(WHICH IS EQIVALENT TO 1151602.00 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 84067541.00 *
(WHICH IS EQIVALENT TO 716993.95 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 395266440.00
(WHICH IS EQIVALENT TO 1711110.12 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 340941168.00
(WHICH IS EQIVALENT TO 1475935.78 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 1638164.03 BTUS
(WHICH IS THE SAME AS 480.12 KW.H)
(WHICH WOULD BE EQUIVALENT TO 2.08 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 27448810.00 BTUS *
(WHICH IS THE SAME AS 8044.79 KW.H)
(WHICH WOULD BE EQUIVALENT TO 34.83 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4.92

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 15.934%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 21.0312 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 117.25 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 638.67
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 274.50
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 84.22
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	10	10	0	15
	: TO	1983	10	14	8	30
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 67342027·00 *
(WHICH IS EQIVALENT TO 1131798·77 BTUS/HR-AVG· *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 41397296·00 *
(WHICH IS EQIVALENT TO 695752·87 BTUS/HR-AVG· *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 185065620·00
(WHICH IS EQIVALENT TO 1770962·86 BTUS/HR - AVG·)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 166312660·00
(WHICH IS EQIVALENT TO 1591508·70 BTUS/HR - AVG·)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 871901·10 BTUS
(WHICH IS THE SAME AS 255·54 KW·H)
(WHICH WOULD BE EQUIVALENT TO 2·45 KW·H AVG· MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 13839876·12 BTUS *
(WHICH IS THE SAME AS 4056·24 KW·H)
(WHICH WOULD BE EQUIVALENT TO 38·82 KW·H AVG· MAINTAINED PER HOUR)

THE C·O·P· OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4·87

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 11·276%

THE RATIO OF THE HEAT PUMP C·O·P· CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 21·9143 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 59·50 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 318·53
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 138·84
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 85·27
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	9	26	0	15
:	TO	1983	10	9	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 241063020·00 *
(WHICH IS EQIVALENT TO 1188966·80 BTUS/HR-AVG· *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 144544462·00 *
(WHICH IS EQIVALENT TO 712919·66 BTUS/HR-AVG· *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 632695392·00
(WHICH IS EQIVALENT TO 1883022·00 BTUS/HR - AVG·)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 573715496·00
(WHICH IS EQIVALENT TO 1707486·59 BTUS/HR - AVG·)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 3029023·16 BTUS
(WHICH IS THE SAME AS 887·76 KW·H)
(WHICH WOULD BE EQUIVALENT TO 2·64 KW·H AVG· MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 46780447·00 BTUS *
(WHICH IS THE SAME AS 13710·56 KW·H)
(WHICH WOULD BE EQUIVALENT TO 40·81 KW·H AVG· MAINTAINED PER HOUR)

THE C·O·P· OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 5·15

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 10·280%

THE RATIO OF THE HEAT PUMP C·O·P· CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 25·9967 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 202·75 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 1140·23
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 470·07
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 83·69
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	9	13	14	45
:	TO	1983	9	25	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 210494122.00 *
(WHICH IS EQIVALENT TO 1143989.78 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 150998214.00 *
(WHICH IS EQIVALENT TO 820642.46 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 495334484.00
(WHICH IS EQIVALENT TO 1664989.86 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 446460924.00
(WHICH IS EQIVALENT TO 1500708.98 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 2781722.87 BTUS
(WHICH IS THE SAME AS 815.28 KW.H)
(WHICH WOULD BE EQUIVALENT TO 2.74 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 42578378.00 BTUS *
(WHICH IS THE SAME AS 12479.01 KW.H)
(WHICH WOULD BE EQUIVALENT TO 41.95 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4.94

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 10.947%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 8.7394 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 184.00 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 995.64
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 428.08
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 85.30
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	8	29	0	15
:	TO	1983	9	13	14	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 260908744·00 *
(WHICH IS EQIVALENT TO 986422·47 BTUS/HR-AVG· *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 156275318·00 *
(WHICH IS EQIVALENT TO 590832·95 BTUS/HR-AVG· *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 588387664·00
(WHICH IS EQIVALENT TO 1573229·05 BTUS/HR - AVG·)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 541816816·00
(WHICH IS EQIVALENT TO 1448708·06 BTUS/HR - AVG·)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 3269567·81 BTUS
(WHICH IS THE SAME AS 958·26 KW·H)
(WHICH WOULD BE EQUIVALENT TO 2·56 KW·H AVG· MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 61388791·00 BTUS *
(WHICH IS THE SAME AS 17992·03 KW·H)
(WHICH WOULD BE EQUIVALENT TO 48·11 KW·H AVG· MAINTAINED PER HOUR)

THE C·O·P· OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4·25

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 8·595%

THE RATIO OF THE HEAT PUMP C·O·P· CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 19·8676 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 264·50 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 1234·10
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 610·20
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 85·01
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

xxx CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY xxx

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	8	17	13	15
	: TO	1983	8	28	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 17891357·50 x
(WHICH IS EQIVALENT TO 832156·16 BTUS/HR-AVG· x)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 7875297·94 x
(WHICH IS EQIVALENT TO 366292·93 BTUS/HR-AVG· x)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 294315672·00
(WHICH IS EQIVALENT TO 1070238·80 BTUS/HR - AVG·)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 278897896·00
(WHICH IS EQIVALENT TO 1014174·16 BTUS/HR - AVG·)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 463690·30 BTUS
(WHICH IS THE SAME AS 135·90 KW·H)
(WHICH WOULD BE EQUIVALENT TO ·49 KW·H AVG· MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 4969779·37 BTUS x
(WHICH IS THE SAME AS 1456·56 KW·H)
(WHICH WOULD BE EQUIVALENT TO 5·30 KW·H AVG· MAINTAINED PER HOUR)

THE C·O·P· OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 3·60

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 5·528%

THE RATIO OF THE HEAT PUMP C·O·P· CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 39·2857 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 21·50 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 84·63
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 51·28
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 82·37
xxx IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH xxx

x NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

xxx CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY xxx

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	8	9	1	0
:	TO	1983	8	17	12	30
	INCLUSIVE					

203.75 hrs.

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS ·00 x
(WHICH IS EQIVALENT TO ·00 BTUS/HR-AVG· x)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS ·00 x
(WHICH IS EQIVALENT TO ·00 BTUS/HR-AVG· x)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 317184256·00
(WHICH IS EQIVALENT TO 1556732·53 BTUS/HR - AVG·)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 282261328·00
(WHICH IS EQIVALENT TO 1385331·66 BTUS/HR - AVG·)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 35007·08 BTUS
(WHICH IS THE SAME AS 10·26 KW·H)
(WHICH WOULD BE EQUIVALENT TO ·05 KW·H AVG· MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS ·00 BTUS x
(WHICH IS THE SAME AS ·00 KW·H)
(WHICH WOULD BE EQUIVALENT TO ·00 KW·H AVG· MAINTAINED PER HOUR)

THE C·O·P· OF THIS HEAT PUMP OVER THIS TIME PERIOD IS ·00

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 12·373%

THE RATIO OF THE HEAT PUMP C·O·P· CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN -100·0000 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS ·00 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ ·00
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ ·33
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ ·53
xxx IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH xxx

x NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

xxx CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY xxx

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERICD :	FROM	1983	7	25	0	15
:	TO	1983	8	7	24	0
	INCLUSIVE					

336 hrs

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS ·00 x
(WHICH IS EQIVALENT TO ·00 BTUS/HR-AVG· x)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS ·00 x
(WHICH IS EQIVALENT TO ·00 BTUS/HR-AVG· x)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 14687855·25
(WHICH IS EQIVALENT TO 43713·85 BTUS/HR - AVG·)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 29971225·75
(WHICH IS EQIVALENT TO 89200·08 BTUS/HR - AVG·)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 172169·11 BTUS
(WHICH IS THE SAME AS 50·46 KW·H)
(WHICH WOULD BE EQUIVALENT TO ·15 KW·H AVG· MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS ·00 BTUS x
(WHICH IS THE SAME AS ·00 KW·H)
(WHICH WOULD BE EQUIVALENT TO ·00 KW·H AVG· MAINTAINED PER HOUR)

THE C·O·P· OF THIS HEAT PUMP OVER THIS TIME PERIOD IS ·00

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN xxxxxx%

THE RATIO OF THE HEAT PUMP C·O·P· CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN -100·0000 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS ·00 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ ·00
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 1·62
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ ·53
xxx IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH xxx

x NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	7	13	15	45
:	TO	1983	7	24	24	0
	INCLUSIVE					

278.5 hrs

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 32641669.00 *
(WHICH IS EQIVALENT TO 920331.03 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 15986379.75 *
(WHICH IS EQIVALENT TO 453514.32 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 106073283.00
(WHICH IS EQIVALENT TO 389259.75 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 89930154.00
(WHICH IS EQIVALENT TO 330018.91 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 600442.55 BTUS
(WHICH IS THE SAME AS 175.93 KW.H)
(WHICH WOULD BE EQUIVALENT TO .65 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 8065142.94 BTUS *
(WHICH IS THE SAME AS 2363.76 KW.H)
(WHICH WOULD BE EQUIVALENT TO 8.67 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4.02

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 17.951%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 34.8841 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 35.25 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 153.45
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 81.78
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 81.84
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	7	4	0	15
:	TO	1983	7	13	15	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 95603842.00 *
(WHICH IS EQIVALENT TO 925945.20 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 55940685.50 *
(WHICH IS EQIVALENT TO 541798.41 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 492585920.00
(WHICH IS EQIVALENT TO 2132406.56 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 482490032.00
(WHICH IS EQIVALENT TO 2088701.42 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 2041050.56 BTUS
(WHICH IS THE SAME AS 598.20 KW.H)
(WHICH WOULD BE EQUIVALENT TO 2.59 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 22259581.25 BTUS *
(WHICH IS THE SAME AS 6523.91 KW.H)
(WHICH WOULD BE EQUIVALENT TO 28.24 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4.29

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 2.092%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 22.2551 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 103.25 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 452.21
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 229.33
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 81.31
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	6	20	0	15
:	TO	1983	7	3	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 190730590.00 *
(WHICH IS EQIVALENT TO 1107289.34 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 107693701.00 *
(WHICH IS EQIVALENT TO 625217.42 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 704159456.00
(WHICH IS EQIVALENT TO 2095712.66 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 618671424.00
(WHICH IS EQIVALENT TO 1841284.00 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 3872469.72 BTUS
(WHICH IS THE SAME AS 1134.96 KW.H)
(WHICH WOULD BE EQUIVALENT TO 3.38 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 40065248.00 BTUS *
(WHICH IS THE SAME AS 11742.45 KW.H)
(WHICH WOULD BE EQUIVALENT TO 34.95 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4.76

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 13.818%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 29.0823 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 172.25 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 902.16
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 414.65
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 86.33
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	6	10	13	30
	: TO	1983	6	19	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 91070450.00 *
(WHICH IS EQIVALENT TO 1074577.58 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 45870823.50 *
(WHICH IS EQIVALENT TO 541248.65 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 428265284.00
(WHICH IS EQIVALENT TO 1888711.28 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 432950508.00
(WHICH IS EQIVALENT TO 1909373.78 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 2884087.72 BTUS
(WHICH IS THE SAME AS 845.28 KW.H)
(WHICH WOULD BE EQUIVALENT TO 3.73 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 18906683.50 BTUS *
(WHICH IS THE SAME AS 5541.23 KW.H)
(WHICH WOULD BE EQUIVALENT TO 24.44 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4.82

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN -1.082%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 40.5896 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 84.75 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 430.76
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 205.65
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 86.59
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** C A L C U L A T I O N S F O R I N D U S T R I A L H E A T P U M P S T U D Y ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	6	6	0	15
:	TO	1983	6	10	12	45
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 95489874.00 *
(WHICH IS EQIVALENT TO 1110347.36 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 60554929.50 *
(WHICH IS EQIVALENT TO 704127.09 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 342615672.00
(WHICH IS EQIVALENT TO 3150488.94 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 312882848.00
(WHICH IS EQIVALENT TO 2877083.66 BTUS/HR - AVG..)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 1536012.14 BTUS
(WHICH IS THE SAME AS 450.18 KW.H)
(WHICH WOULD BE EQUIVALENT TO 4.14 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 19589219.75 BTUS *
(WHICH IS THE SAME AS 5741.27 KW.H)
(WHICH WOULD BE EQUIVALENT TO 52.79 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4.87

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 9.503%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 19.1477 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 86.00 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 451.67
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 199.36
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 86.06
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** C A L C U L A T I O N S F O R I N D U S T R I A L H E A T P U M P S T U D Y ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	5	23	0	15
:	TO	1983	6	5	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 121636430.00 *
(WHICH IS EQIVALENT TO 1055413.70 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 69855090.00 *
(WHICH IS EQIVALENT TO 606117.91 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 654382104.00
(WHICH IS EQIVALENT TO 1947565.78 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 567408152.00
(WHICH IS EQIVALENT TO 1688714.73 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 4705876.81 BTUS
(WHICH IS THE SAME AS 1379.21 KW.H)
(WHICH WOULD BE EQUIVALENT TO 4.10 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 25145716.25 BTUS *
(WHICH IS THE SAME AS 7369.79 KW.H)
(WHICH WOULD BE EQUIVALENT TO 21.93 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4.84

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 15.328%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 28.0373 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 115.25 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 575.34
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 281.72
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 86.33
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	5	12	16	45
:	TO	1983	5	22	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 119735566.00 *
(WHICH IS EQIVALENT TO 997796.38 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 64206395.50 *
(WHICH IS EQIVALENT TO 535053.29 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 502261308.00
(WHICH IS EQIVALENT TO 2029338.61 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 434627472.00
(WHICH IS EQIVALENT TO 1756070.59 BTUS/HR - AVG..)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 3374593.97 BTUS
(WHICH IS THE SAME AS 989.04 KW.H)
(WHICH WOULD BE EQUIVALENT TO 4.00 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 26262662.75 BTUS *
(WHICH IS THE SAME AS 7697.15 KW.H)
(WHICH WOULD BE EQUIVALENT TO 31.10 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4.56

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 15.561%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 32.3497 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 120.00 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 566.35
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 279.70
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 86.59
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	4	25	0	15
:	TO	1983	5	1	3	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 73690662.00 *
(WHICH IS EQIVALENT TO 909761.26 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 36059006.00 *
(WHICH IS EQIVALENT TO 445172.91 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 337955048.00
(WHICH IS EQIVALENT TO 2299013.91 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 295811716.00
(WHICH IS EQIVALENT TO 2012324.59 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 1871752.70 BTUS
(WHICH IS THE SAME AS 548.58 KW.H)
(WHICH WOULD BE EQUIVALENT TO 3.73 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 17917432.25 BTUS *
(WHICH IS THE SAME AS 5251.31 KW.H)
(WHICH WOULD BE EQUIVALENT TO 35.72 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4.11

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 14.247%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 36.5236 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 81.00 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 348.56
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 186.76
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 84.74
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	4	11	0	15
	: TO	1983	4	24	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 60920751.00 *
(WHICH IS EQIVALENT TO 974732.02 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 39425109.00 *
(WHICH IS EQIVALENT TO 630801.74 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 754784536.00
(WHICH IS EQIVALENT TO 2246382.53 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 659611888.00
(WHICH IS EQIVALENT TO 1963130.61 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 4345573.19 BTUS
(WHICH IS THE SAME AS 1273.61 KW.H)
(WHICH WOULD BE EQUIVALENT TO 3.79 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 13606905.12 BTUS *
(WHICH IS THE SAME AS 3987.96 KW.H)
(WHICH WOULD BE EQUIVALENT TO 11.87 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4.48

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 14.429%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 14.8754 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 62.50 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 288.16
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 169.42
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 97.68
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	3	29	15	15
:	TO	1983	4	10	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 10847768.50 *
(WHICH IS EQIVALENT TO 1009094.74 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 7334902.81 *
(WHICH IS EQIVALENT TO 682316.54 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 567257392.00
(WHICH IS EQIVALENT TO 1909957.55 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 564584424.00
(WHICH IS EQIVALENT TO 1900957.66 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 4190602.47 BTUS
(WHICH IS THE SAME AS 1228.20 KW.H)
(WHICH WOULD BE EQUIVALENT TO 4.14 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 2552448.00 BTUS *
(WHICH IS THE SAME AS 748.08 KW.H)
(WHICH WOULD BE EQUIVALENT TO 2.52 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4.25

THE RATIO OFHX (BFW-BTUS OUT)/(SOURCE BTUS IN) IS WITHIN .473%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 9.7136 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 10.75 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 51.31
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 63.64
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 99.26
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	3	14	0	15
:	TO	1983	3	29	14	45
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 2483364.09 *
(WHICH IS EQIVALENT TO 993345.63 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 2114214.66 *
(WHICH IS EQIVALENT TO 845685.86 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 860783776.00
(WHICH IS EQIVALENT TO 2296954.69 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 852927760.00
(WHICH IS EQIVALENT TO 2275991.34 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 3907884.25 BTUS
(WHICH IS THE SAME AS 1145.34 KW.H)
(WHICH WOULD BE EQUIVALENT TO 3.06 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 460619.75 BTUS *
(WHICH IS THE SAME AS 135.00 KW.H)
(WHICH WOULD BE EQUIVALENT TO .36 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 5.39

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN .921%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN -3.5525 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 2.50 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 11.75
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 41.23
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 101.90
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD	: FROM	1983	2	28	16	0
	: TO	1983	3	13	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS .00 *
(WHICH IS EQIVALENT TO .00 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS .00 *
(WHICH IS EQIVALENT TO .00 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 770955200.00
(WHICH IS EQIVALENT TO 2407354.25 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 731985912.00
(WHICH IS EQIVALENT TO 2285670.28 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 3401613.16 BTUS
(WHICH IS THE SAME AS 996.96 KW.H)
(WHICH WOULD BE EQUIVALENT TO 3.11 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS .00 BTUS *
(WHICH IS THE SAME AS .00 KW.H)
(WHICH WOULD BE EQUIVALENT TO .00 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS .00

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 5.324%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN -100.0000 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS .00 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ .00
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 32.10
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 4.22
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	2	14	0	15
:	TO	1983	2	28	15	15
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 52817169.00 *
(WHICH IS EQIVALENT TO 1193608.33 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 36932900.00 *
(WHICH IS EQIVALENT TO 834641.80 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 855500808.00
(WHICH IS EQIVALENT TO 2435589.47 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 746465632.00
(WHICH IS EQIVALENT TO 2125169.03 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 3937569.41 BTUS
(WHICH IS THE SAME AS 1154.04 KW.H)
(WHICH WOULD BE EQUIVALENT TO 3.29 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 9469520.25 BTUS *
(WHICH IS THE SAME AS 2775.36 KW.H)
(WHICH WOULD BE EQUIVALENT TO 7.90 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 5.58

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 14.607%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 13.8242 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 44.25 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 249.83
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 126.53
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 102.96
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** C A L C U L A T I O N S F O R I N D U S T R I A L H E A T P U M P S T U D Y ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	2	3	17	30
:	TO	1983	2	13	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 106259158.00 *
(WHICH IS EQIVALENT TO 1214390.37 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 83648517.00 *
(WHICH IS EQIVALENT TO 955983.05 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 596680352.00
(WHICH IS EQIVALENT TO 2418157.44 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 466618708.00
(WHICH IS EQIVALENT TO 1891058.58 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 2945093.03 BTUS
(WHICH IS THE SAME AS 863.16 KW.H)
(WHICH WOULD BE EQUIVALENT TO 3.50 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 18588960.75 BTUS *
(WHICH IS THE SAME AS 5448.11 KW.H)
(WHICH WOULD BE EQUIVALENT TO 22.08 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 5.72

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 27.873%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 3.9337 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 87.50 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 502.61
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 203.22
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 99.53
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	1	31	0	15
:	TO	1983	2	3	17	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 21389370.00 *
(WHICH IS EQIVALENT TO 983419.30 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 16260456.12 *
(WHICH IS EQIVALENT TO 747607.17 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 285923700.00
(WHICH IS EQIVALENT TO 3212625.81 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 289620568.00
(WHICH IS EQIVALENT TO 3254163.66 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 1036700.91 BTUS
(WHICH IS THE SAME AS 303.84 KW.H)
(WHICH WOULD BE EQUIVALENT TO 3.41 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 3930212.00 BTUS *
(WHICH IS THE SAME AS 1151.88 KW.H)
(WHICH WOULD BE EQUIVALENT TO 12.94 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 5.44

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN -1.276%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN 5.9369 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 21.75 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 101.17
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 46.87
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 105.07
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1983	1	17	0	15
	: TO	1983	1	30	24	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 38704923.50 *
(WHICH IS EQIVALENT TO 1060408.86 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 32399402.50 *
(WHICH IS EQIVALENT TO 887654.86 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 836279216.00
(WHICH IS EQIVALENT TO 2488926.22 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 736349704.00
(WHICH IS EQIVALENT TO 2191516.97 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 2689397.16 BTUS
(WHICH IS THE SAME AS 788.22 KW.H)
(WHICH WOULD BE EQUIVALENT TO 2.35 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 6690654.00 BTUS *
(WHICH IS THE SAME AS 1960.92 KW.H)
(WHICH WOULD BE EQUIVALENT TO 5.84 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 5.78

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 13.571%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN -.9852 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS 36.50 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 183.07
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 88.52
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 104.81
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE

*** CALCULATIONS FOR INDUSTRIAL HEAT PUMP STUDY ***

		YEAR	MONTH	DAY	HR	MIN
STUDY TIME PERIOD :	FROM	1982	12	15	0	15
:	TO	1982	12	30	13	0
	INCLUSIVE					

TOTAL BTUS FOR TIME PERIOD SPECIFIED

BTUS ACROSS HEAT PUMP ON BOILER FEED WATER LINE IS 879867.02 *
(WHICH IS EQIVALENT TO 1173156.03 BTUS/HR-AVG. *)

BTUS ACROSS HEAT PUMP ON SOURCE FEED LINE IS 828523.22 *
(WHICH IS EQIVALENT TO 1104697.62 BTUS/HR-AVG. *)

BTUS ACROSS HEAT EXCHANGER ON BOILER FEED LINE IS 427385356.00
(WHICH IS EQIVALENT TO 1145805.23 BTUS/HR - AVG.)

BTUS ACROSS HEAT EXCHANGER ON SOURCE FEED LINE IS 356278112.00
(WHICH IS EQIVALENT TO 955169.20 BTUS/HR - AVG.)

ENERGY USED TO DRIVE VARIABLE SPEED PUMP OVER PERIOD SPECIFIED IS 385281.59 BTUS
(WHICH IS THE SAME AS 112.92 KW.H)
(WHICH WOULD BE EQUIVALENT TO .30 KW.H AVG. MAINTAINED PER HOUR)
ENERGY USED TO DRIVE HEAT PUMP OVER THIS PERIOD IS 193255.62 BTUS *
(WHICH IS THE SAME AS 56.64 KW.H)
(WHICH WOULD BE EQUIVALENT TO .15 KW.H AVG. MAINTAINED PER HOUR)

THE C.O.P. OF THIS HEAT PUMP OVER THIS TIME PERIOD IS 4.55

THE RATIO OFHX (BFW BTUS OUT)/(SOURCE BTUS IN) IS WITHIN 19.958%

THE RATIO OF THE HEAT PUMP C.O.P. CALCULATION
(BTUS OUT/ BTUS IN) IS WITHIN -13.8887 %
THE # OF HOURS THAT THE HEAT PUMP WAS LOADED ABOVE 20% IS .75 HRS

THE WORTH OF THE RECLAIMED HEAT AT THE CONDENSER IS $ 4.16
THE COST OF THE ELECTRICAL ENERGY FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR IS $ 5.46
THE DEMAND CHARGE FOR THE VARIABLE SPEED PUMP PLUS THE COMPRESSOR WOULD BE $ 98.47
*** IF THE MAXIMUM ELECTRICAL DEMAND DURING THIS TIME PERIOD IS THE MAXIMUM FOR THE MONTH ***

* NOTE: THE ABOVE CALCULATIONS ARE BASED ON HEAT PUMP MINIMUM LOADING OF 20% OR MORE